Sociotechnical Synthesis

(Executive Summary)

Creating Meaningful Diabetes Data Insights and Improving Access to these Tools

For my major's capstone, I worked on improving a diabetes data platform (Tidepool) that integrates information from continuous glucose monitors (CGMs), insulin pumps, and other diabetes devices to provide patients with nuanced, actionable insights into their blood glucose patterns. As I reflected on the potential impact of this project, I began to question which patients, and how many, would actually have access to these improvements. My research revealed that while many patients obtain CGMs and insulin pumps through insurance, access to both the devices and insurance itself is highly inequitable across the United States. To ensure that my work could benefit the greatest number of users, it became clear that more people would need access not only to Tidepool's services but also to the essential devices required to use the platform effectively. This realization led me to focus my STS work on the structural factors that drive disparities in device access, particularly through an examination of the American health insurance system and the policies that shape who can obtain CGMs and insulin pumps. I analyzed how these systems affect not only device access but also broader societal outcomes, ultimately proposing solutions to reduce these disparities and promote more equitable care. By linking technical innovation with a critical understanding of structural barriers, I hope my work contributes to both improved diabetes care and a more just healthcare system.

For the technical portion of my project, I collaborated with Tidepool, a nonprofit organization that delivers diabetes data insights by integrating information from CGMs, insulin

pumps, and other devices. Our focus was to enhance the Tidepool interface to make it more intuitive and empowering for users. One of my key contributions was developing a graph and algorithm capable of predicting the times of day or week when a patient is most likely to experience high or low blood glucose events. This helps patients identify patterns and prepare accordingly. I also designed a five-minute monthly summary feature that distills key trends, such as time-in-range and average glucose levels, into concise, personalized insights. To support these tools, I created a workflow of prompts aligned with each patient's high-risk timeframes, offering context and potential explanations for their glucose fluctuations. Ultimately, our goal was to transform Tidepool into a platform that not only informs but also empowers patients to manage their condition more confidently. The significance of this work lies in its planned incorporation into the Tidepool platform. The algorithm and design principles could serve as a foundation for further improvements and broader applications in patient-centered digital health tools.

In my STS project, I explored how the American health insurance system influences access to essential diabetes devices. I examined programs such as Medicare, Medicaid, and employer-based insurance to understand how coverage varies across populations. My analysis revealed significant disparities driven by employment status, income, and geography. To better understand these dynamics, I used two theoretical frameworks: the political economy of health and risk society theory. The political economy of health highlights how political and economic systems interact to shape health outcomes, particularly when corporate involvement in medical device production prioritizes profit over patient well-being. Risk society theory emphasizes how modern systems create and manage manufactured risks, like patients' unstable access to devices due to shifting policies and restrictive coverage requirements. Drawing on these insights, I proposed several solutions, including standardizing insurance coverage for diabetes devices

across states, mandating employer-provided coverage, and introducing a public competitor to lower device costs. Rebuilding trust in the system will also require holding insurers and manufacturers accountable for coverage gaps and price increases.

By considering the technical, organizational, and cultural elements of my project together, I came to understand how engineering solutions must be informed by the systems in which they exist. While my technical work focused on improving Tidepool's interface to provide actionable insights, the STS lens revealed that such innovations can only be impactful if more patients have equitable access to the technologies they depend on. Organizational factors, such as how insurance policies determine who receives coverage, and cultural dynamics of trust, vulnerability, and health equity deeply influence how technology is used and who benefits from it. STS frameworks like the political economy of health and risk society theory helped me recognize that technical progress alone is not enough. Ethical responsibility in engineering also involves confronting the societal barriers that limit access and reinforce disparities. This integrated perspective enabled me to design not just for functionality, but for fairness and inclusivity—reminding me that responsible engineering must be grounded in the lived realities of the people it aims to serve.